

(12) UK Patent Application (19) GB (11) 2 090 814 A

(21) Application No 8200162

(22) Date of filing  
5 Jan 1982

(30) Priority data  
(31) 81/00637

(32) 9 Jan 1981

(33) United Kingdom (GB)

(43) Application published  
21 Jul 1982

(51) INT CL<sup>3</sup> G01N 1/20

(52) Domestic classification  
B8N 12A2 TA

(56) Documents cited  
None

(58) Field of search  
B8N

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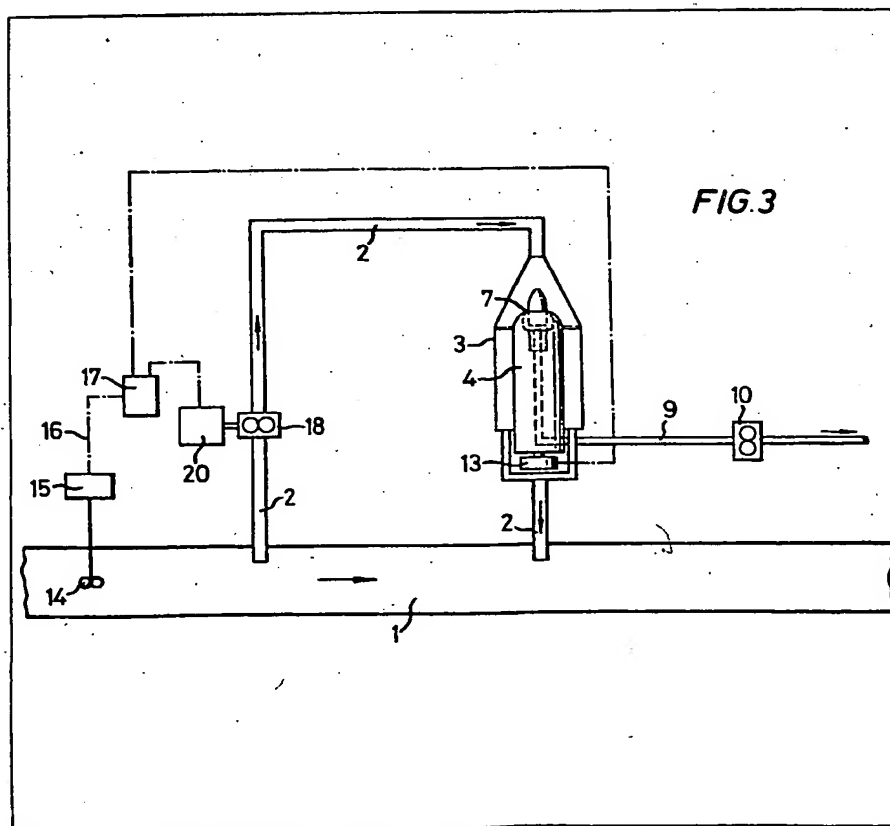
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(54) Continuous sampling method  
and apparatus thereof

(57) An apparatus for extracting  
samples of a fluid flowing through a  
main stream pipe line (1) compris-  
ing:

a by-pass loop (2) in which is  
located a chamber (3), b. for  
sampling a portion of the fluid  
passing through the by-pass-loop;  
c. Means (14) responsive to the  
main stream fluid velocity varies the  
internal cross sectional area of the  
chamber at the sample withdrawal  
point so as to maintain a constant  
fluid velocity through the chamber.  
The means for varying the internal  
cross sectional area of the chamber  
at the sample withdrawal point  
comprises a movable hollow probe,  
through which the sample is with-  
drawn, which is adapted to be posi-  
tioned at points of varying cross

sectional area along the axis of a  
chamber having an expanding pro-  
file, and which is controlled by  
means of a standard linear activat-  
ing control device operated by  
pneumatic, hydraulic or electrical  
means responsive to changes in the  
main stream fluid velocity.



The drawing(s) originally filed was/were informal and the print here reproduced is taken from a later filed formal copy.

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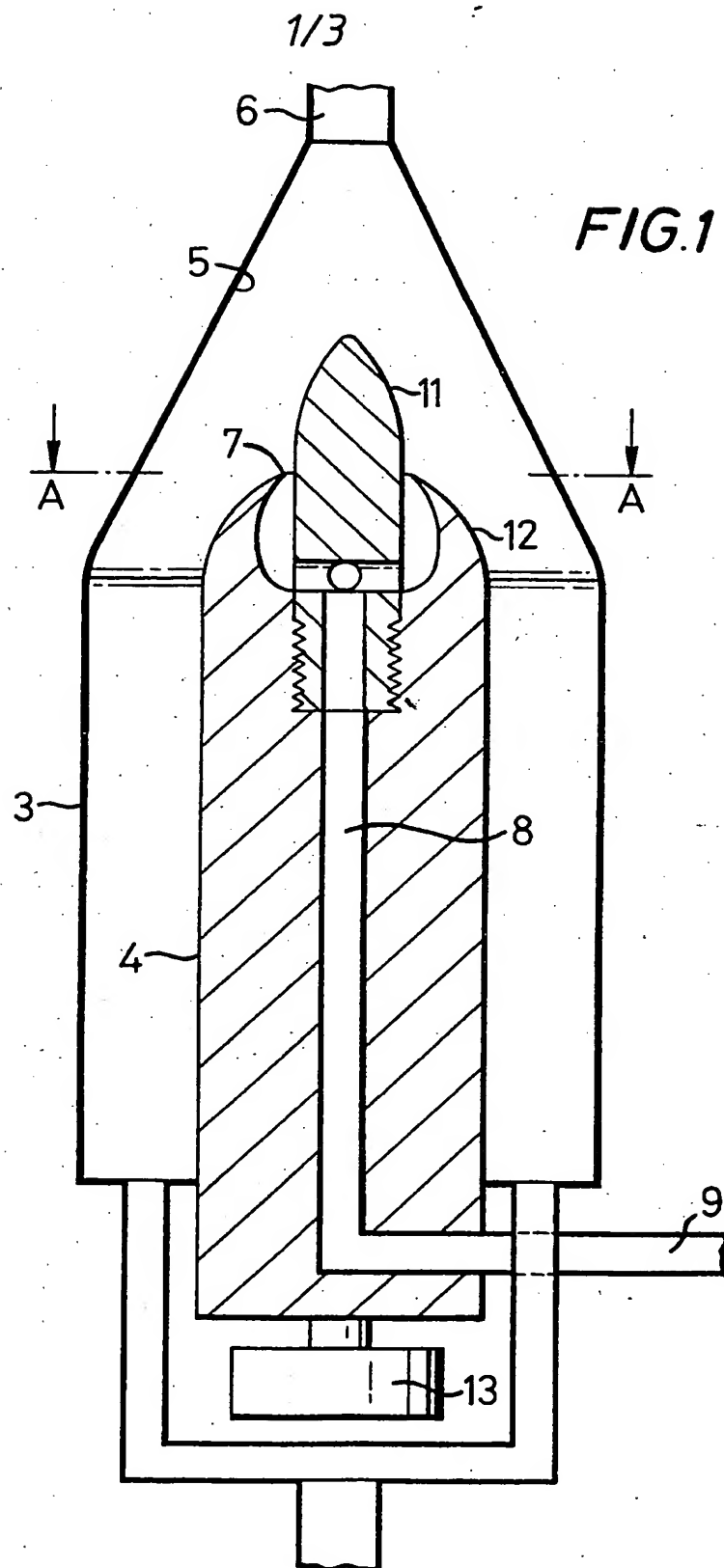
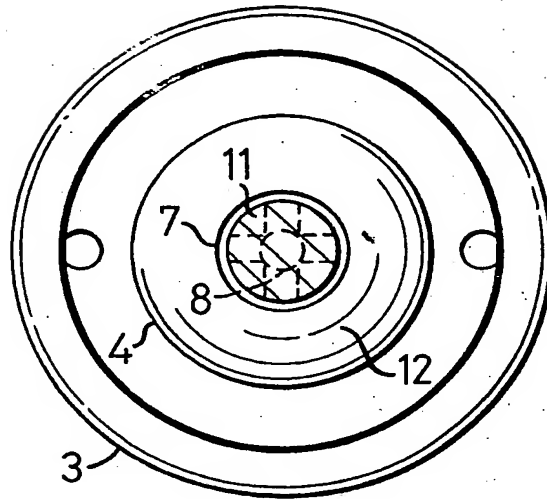
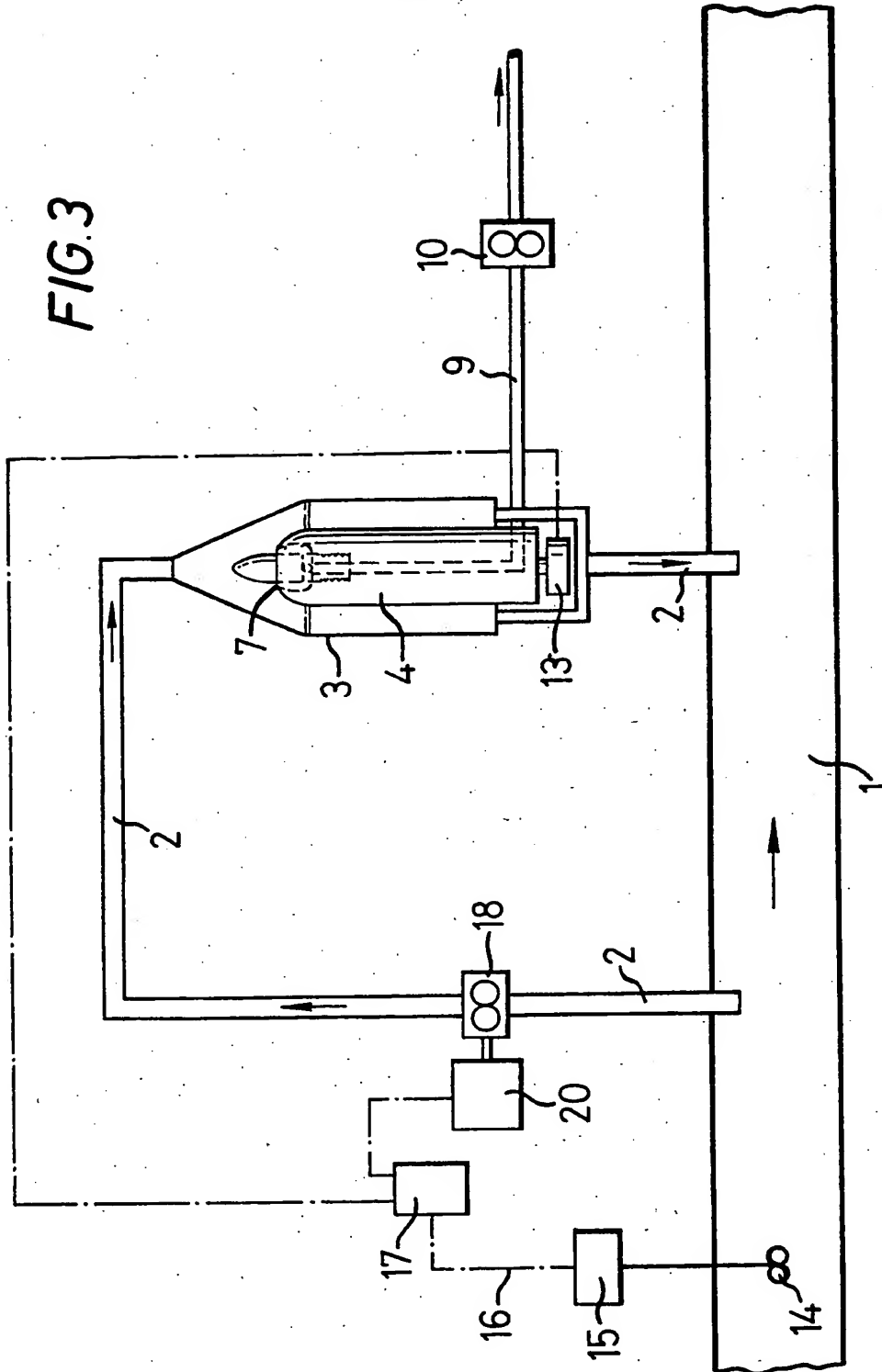


FIG. 2



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FIG. 3



## SPECIFICATION

**Continuous sampling method and apparatus therefor**

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The present invention relates to an apparatus and a method for continuously extracting fluid samples from a main stream, for instance a mixture of oil and water in a pipe line.

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In recent years the accurate measurement of the amount of water in crude oil has become of increasing importance; hence there has been a need to develop improved sampling methods. In a crude oil pipe line the

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flow of discontinuous phase water is rarely uniform with time, transient water slugs normally being present, and it is necessary to ensure that such transient water slugs do not cause the collected sample to be unrepresentative of the pipe line throughput. In one

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method of sampling part of the pipe line flow is continuously diverted through a by-pass loop, from which a sample is extracted after the fluid has been thoroughly mixed, the

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remainder of the fluid in the loop being returned to the pipe line. In such a sampling method the liquid is pumped through the by-pass loop at the same fluid velocity as in the pipe line, but for the method to be valid it is necessary to ensure that the liquid flows past the sample extraction point in the by-pass loop at a constant velocity substantially equal to the velocity of extraction of the sample, regardless of changes in the velocity of the liquid in the main pipe line. Otherwise the effects of momentum on entrained particles of different density from the continuous phase oil will lead to unrepresentative sampling.

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Accordingly, the present invention relates to an apparatus for extracting samples of a fluid flowing through a main stream pipe line, said apparatus comprising:

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1. means for continuously diverting part of the fluid in the pipe line through a by-pass loop in which is located a chamber,

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2. means for continuously withdrawing from the chamber at a sample withdrawal point for transmission to an automatic sampling device a portion of the fluid passing through the by-pass loop, and

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3. means responsive to the main stream fluid velocity for varying the internal cross sectional area of the chamber at the sample withdrawal point so as to maintain a constant fluid velocity through the chamber at the sample withdrawal point.

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The invention also relates to a method for extracting samples of a fluid flowing through a main stream pipe line which comprises continuously diverting part of the fluid in the pipe line through a by-pass loop in which is located a chamber, continuously withdrawing from the chamber at a sample withdrawal point a portion of the fluid passing through the by-pass loop and transmitting this portion

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to an automatic sampling device and varying the internal cross sectional area of the chamber at the sample withdrawal point in response to changes in the main stream fluid velocity so as to maintain a constant velocity through the chamber at the sample withdrawal point.

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In the apparatus and method of the present invention the velocity of the liquid passing

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through the chamber at the sample withdrawal point is maintained constant by varying the internal cross sectional area of the chamber at that point in response to changes in the velocity of the fluid in the main pipe

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line. Thus when the main stream flow rate increases the chamber cross sectional area is increased proportionately to correct the tendency of the flow rate in the chamber to increase and to maintain this at a constant

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level. Likewise when the main stream flow rate decreases, the chamber cross sectional area is also decreased proportionately to maintain a constant flow rate through the chamber at the sample withdrawal point.

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The means for varying the internal cross sectional area of the chamber at the sample withdrawal point may comprise for instance means for applying pressure externally to a chamber with flexible walls to create a venturi-

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like profile within the chamber, which profile can be varied in response to changes in the main stream fluid velocity. In this case the sample withdrawal point in the chamber is suitably a tube axially positioned in the chamber with an inlet at the point of variable cross

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sectional area facing towards the flow of fluid and an outlet external to the chamber which can be connected to an automatic sampling device.

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In a preferred embodiment of the invention the means for varying the internal cross sectional area of the chamber at the sample withdrawal point comprise a movable hollow probe, through which the sample is with-

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drawn, which can be positioned at points of varying cross sectional area along the axis of a chamber having an expanding profile. In this embodiment the chamber has rigid walls and a profile which expands uniformly in the direc-

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tion of flow from the point of entry of the fluid to a maximum cross section. The probe has an inlet facing towards the flow of fluid in the expanding part of the chamber, and is suitably profiled to avoid undue disturbance of

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the flow patterns which could cause preferential flow of either oil or water into the inlet, and an outlet external to the chamber which can be connected to an automatic sampling device. The position of the probe in the chamber is controlled by means of a standard linear activating control device operated by pneumatic, hydraulic or electrical means responsive to

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changes in the main stream fluid velocity. Fluid entering the chamber is thoroughly

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mixed by the turbulence created at the sud-

den expansion, and the expanding profile also causes a progressive decrease in the fluid velocity through the chamber. Movement of the probe in the chamber in response to signals from the control device maintains the sample withdrawal point i.e. the probe inlet in a region of constant fluid velocity.

Preferably the head of the probe has a tapered profile which matches the profile of the expanding portion of the chamber, and the inlet is an annulus located on the shoulders of the probe connected with a central axial tube in the probe.

The probe outlet is suitably connected to a conventional automatic sampling unit such as that described in our British Patent Specification No: 1501903. This specification describes an automatic sampling device which comprises a conduit formed as a loop having ends which are adapted to be in open communication with a liquid source, a gear pump capable of circulating liquid at a substantially constant rate through the loop, a sample outlet valve in the loop downstream from the pump and a back pressure valve adapted to control the flow passage through the sample outlet and responsive to the upstream line pressure.

The apparatus of the present invention is further described with reference to the accompanying drawings in which

Figure 1 represents a sectional view of a chamber and probe forming part of an apparatus according to the invention,

Figure 2 represents a view of the probe along section AA in Fig. 1, and

Figure 3 represents a schematic diagram of a method according to the invention.

Referring to the drawings, an apparatus for continuously extracting samples of a fluid flowing through a main stream pipe line 1 comprises a by-pass loop 2 in which is located a chamber 3 containing a movable hollow probe 4 through which the sample may be withdrawn. The chamber 3 has rigid walls and a profile 5 which expands uniformly in the direction of flow from the inlet 6 to a maximum cross section. The probe 4 has an annular inlet 7 connected to an axial tube 8 and an outlet 9 external to the chamber connected to an extracting gear pump 10. The probe 4 has a head 11 and shoulders 12 which are profiled to match the profile 5 of the chamber. The probe 4 is mounted on a pneumatic cylinder 13 which causes it to move axially within the chamber towards or away from the inlet 6 in response to changes in the fluid velocity in the pipe line 1.

In operation the fluid velocity in the pipe line 1 is measured by the device 14 and flow metering unit 15, and signals from the metering unit 15 are fed by a line 16 into the controller 17. Part of the fluid in the pipe line 1 is diverted through the by-pass loop 2 and chamber 3 by means of the pump 18, the

bulk of the fluid returning to the pipe line through the chamber outlet 19. The rate of extraction by the pump 18 is governed by a motor 20 which in turn is controlled by the controller 17, so as to maintain the fluid velocity in by-pass loop 2 substantially the same as in pipe line 1. A sample of the fluid passing through the chamber 3 is continually extracted through the probe 4 by means of the extracting gear pump 10, and passed to an automatic sampling device (not shown).

The position of the probe 4 in the chamber is controlled by the pneumatic cylinder 13 into which signals are fed from the controller 17 indicating changes in the fluid velocity in the pipe line 1, so that the position of the annular inlet 7, which forms the sample withdrawal point, is maintained within the expanding portion of the chamber at a position of constant fluid velocity substantially equal to the velocity of extraction of the sample.

#### CLAIMS

1. An apparatus for extracting samples of a fluid flowing through a main stream pipe line, said apparatus comprising:
  - a. means for continuously diverting part of the fluid in the pipe line through a by-pass loop in which is located a chamber,
  - b. means for continuously withdrawing from the chamber at a sample withdrawal point for transmission to an automatic sampling device a portion of the fluid passing through the by-pass loop, and
  - c. means responsive to the main stream fluid velocity for varying the internal cross sectional area of the chamber at the sample withdrawal point so as to maintain a constant fluid velocity through the chamber at the sample withdrawal point.
2. An apparatus according to claim 1 wherein the means for varying the internal cross sectional area of the chamber at the sample withdrawal point comprises means for applying pressure externally to a chamber with flexible walls to create a venturi-like profile within the chamber, which profile is variable in response to changes in the main stream fluid velocity.
3. An apparatus according to claim 2 wherein the sample withdrawal point in the chamber is a tube axially positioned in the chamber with an inlet at the point of variable cross sectional area facing towards the flow of fluid and an outlet external to the chamber which is connected to an automatic sampling device.
4. An apparatus according to claim 1 wherein the means for varying the internal cross sectional area of the chamber at the sample withdrawal point comprises a movable hollow probe, through which the sample is withdrawn, which is adapted to be positioned at points of varying cross sectional area along the axis of a chamber having an expanding

profile.

5. An apparatus according to claim 4 wherein the chamber has rigid walls and a profile which expands uniformly in the direction of flow from the point of entry of the fluid to a maximum cross section.

6. An apparatus according to claim 4 or 5 wherein the probe has an inlet facing towards the flow of fluid in the expanding part of the chamber, and is profiled to avoid undue disturbance of the flow patterns which cause preferential flow of any one component of the fluid into the inlet, and an outlet external to the chamber which is connected to an automatic sampling device.

7. An apparatus according to any one of the preceding claims 4 to 6 wherein the profile of the expanding portion of the chamber, and the inlet is an annulus located on the shoulders of the probe connected with a central axial tube in the probe.

8. An apparatus according to any one of the preceding claims 4 to 7 wherein the position of the probe in the chamber is controlled by means of a standard linear activating control device operated by pneumatic, hydraulic or electrical means responsive to changes in the main stream fluid velocity.

9. A method for extracting samples of a fluid flowing through a main stream pipe line which comprises continuously diverting part of the fluid in the pipeline through a by-pass loop in which is located a chamber, continuously withdrawing from the chamber at a sample withdrawal point a portion of the fluid passing through the by-pass loop and transmitting this portion to an automatic sampling device and varying the internal cross sectional area of the chamber at the sample withdrawal point in response to changes in the main stream fluid velocity so as to maintain a constant velocity through the chamber at the sample withdrawal point.

10. A method according to claim 9 wherein the velocity of the liquid passing through the chamber at the sample withdrawal point is maintained constant by varying the internal cross sectional area of the chamber at that point in response to changes in the velocity of the fluid in the main pipe line using an apparatus described in any one of the preceding claims 1 to 8.